

## CLAIMS

What is claimed is:

1. A process for a computer-implemented  
5 hierarchical multidimensional scaling database for  
images, the process comprising:

measuring dissimilarity of a set of images  
using a feature detector;

10 obtaining a set of distances between control  
points corresponding to images in a root node;

performing a single node update at the root  
node to determine a first position in the root  
node of an image being queried or added;

15 determining a first bounding box for a first  
subnode, wherein the first subnode is a child of  
the root node; and

determining a list of traversed nodes and  
traversed control points, performing a single node  
update at the first subnode, and sorting distances  
20 to the traversed control points in the traversed  
nodes, wherein the first subnode is a leaf node.

2. The process of Claim 1 further comprising:

25 obtaining a list of images in a second  
subnode, wherein the second subnode is the child  
of the first subnode; and

repeating the performing of the single node  
update and the determining of a second bounding  
box for the second subnode.

30

3. A process for a computer-implemented  
hierarchical multidimensional scaling database of  
objects, the process comprising:

35 determining distances between control points  
corresponding to objects in a root node of the

hierarchical multidimensional scaling database of objects; and

determining a position of a first control point in the root node for a first object, wherein the first object is being queried, and wherein the hierarchical multidimensional scaling database of objects comprises the root node and a first subnode, the first subnode being a child of the root node.

4. The process of Claim 3 further comprising:  
traversing a first subnode and performing a single node update on the first subnode;

performing the single node update at a leaf node, the leaf node being a descendant of the first subnode; and

determining traversed subnodes and traversed control points, and sorting distances between the traversed control points in the traversed subnodes and the control points in the root node to the first control point.

5. The process of Claim 4 further comprising:  
adding the first object to the hierarchical multidimensional scaling database, wherein the leaf node is subdivided if the leaf node is full, and wherein multidimensional scaling is executed on the leaf node and all bounding boxes in the traversed path to the first control point are updated.

6. The process of Claim 3 further comprising:  
initializing the hierarchical multidimensional scaling database of objects by

executing instructions for approximating a convex hull.

7. The process of Claim 6 wherein the hierarchical multidimensional scaling database of objects comprises a hierarchical multidimensional scaling representation of images, the images being stored in a memory of a data processing device.

8. A process for a computer-implemented hierarchical spatial database of objects, the process comprising:

calculating multiple stress vectors; wherein the multiple stress vectors represent stress factors between a first control point and multiple control points of the hierarchical spatial database, and wherein the multiple control points correspond to multiple objects, and the first control point corresponds to an object being queried; and

mapping the multiple stress vectors to multiple deformation vectors;

combining the multiple deformation vectors into a single node update vector; and

updating the first control point by moving a position of the first control point based on a fraction of the single node update vector.

9. The process of Claim 8 wherein the multiple control points comprise multiple source control points, and the first control point comprises a target control point, wherein the calculating of the multiple stress vectors further comprises:

storing values for multiple source bundle fields and multiple target bundle fields; and

determining multiple source field values, the multiple source field values corresponding to the multiple source control points, the multiple source control points being in a neighborhood of the target control point,

wherein a position of the target control point is modified using the source field values, and wherein the stress on the target control point in a node of the hierarchical spatial database is minimized.

10. The process of Claim 9 wherein the fields comprise local fields.

11. The process of Claim 9 wherein the fields comprise anisotropic fields.

12. An article of manufacture for a hierarchical multidimensional scaling database for objects, the article of manufacture comprising:

a configuration for the hierarchical multidimensional scaling database, the hierarchical multidimensional scaling database comprising a root node and a leaf node, the leaf node being a subnode of the root node, wherein the root node and the leaf node each comprise control points corresponding to objects; and

a query manager, the query manager comprising executable instructions for querying the hierarchical multidimensional scaling database of objects.

13. The article of manufacture of Claim 12 wherein the executable instructions of the query manager further comprise:

instructions for obtaining a set of distances between control points corresponding to images in a root node; .

5 instructions for performing a single node update at the root node to determine a position in the root node of an image being queried or added;

instructions for determining a bounding box for a first subnode, wherein the first subnode is a child of the root node; and

10 instructions for determining a list of traversed nodes and traversed control points, performing the single node update at the first subnode, and sorting distances to the traversed control points in the traversed nodes, wherein the first subnode is a leaf node.

14. The article of manufacture of Claim 12, the executable instructions of the query manager further comprising:

20 instructions for calculating multiple stress vectors, wherein the multiple stress vectors represent stress between a first control point and multiple control points of a node of the hierarchical multidimensional scaling database, and wherein the multiple control points correspond to multiple objects, and the first control point corresponds to an object being queried; and

instructions for mapping the multiple stress vectors to multiple deformation vectors;

30 instructions for combining the multiple deformation vectors into a single node update vector; and

instructions for modifying a position of the first control point by moving the position of the

first control point a fraction of the single node update vector.

15        15. The article of manufacture of Claim 12, the executable instructions of the query manager further comprising:

          instructions for storing values for multiple source bundle fields and multiple target bundle fields; and

10            instructions for determining multiple source field values, the multiple source field values corresponding to multiple source control points, the multiple source control points being in a neighborhood of a target control point,

15            wherein a position of the target control point is modified using the source field values, and wherein the stress on the target control point in a node of the hierarchical multidimensional scaling database is minimized.

20

          16. The article of manufacture of Claim 15 wherein the instructions are implemented in a C++ programming language.

25        17. A machine executing instructions for a hierarchical multidimensional scaling database for objects, the machine comprising:

          instructions executed on a microprocessor of the machine for managing a configuration of the hierarchical multidimensional scaling database; and

30            instructions executed on the microprocessor of the machine for querying the hierarchical multidimensional scaling database, the objects being stored in a memory.

35

18. The machine of Claim 17 further comprising:

instructions executed on the microprocessor  
of the machine for obtaining a set of distances  
between control points corresponding to images in  
a root node;

instructions executed on the microprocessor  
of the machine for performing a single node update  
at the root node to determine a position in the  
root node of an image being queried or added;

instructions executed on the microprocessor  
of the machine for determining a bounding box for  
a first subnode, wherein the first subnode is a  
child of the root node; and

instructions executed on the microprocessor  
of the machine for determining a list of traversed  
nodes and traversed control points, performing a  
single node update at the first subnode, and  
sorting distances to the traversed control points  
in the traversed nodes, wherein the first subnode  
is a leaf node.

19. The machine of Claim 17 further comprising:

instructions executed on the microprocessor  
of the machine for calculating multiple stress  
vectors, wherein the multiple stress vectors  
represent stress between a first control point and  
multiple control points of a node of the  
hierarchical multidimensional scaling database,  
and wherein the control points correspond to  
multiple objects, and the first control point  
corresponds to an object being queried; and

instructions executed on the microprocessor  
of the machine for mapping the multiple stress  
vectors to multiple deformation vectors;

instructions executed on the microprocessor of the machine for combining the multiple deformation vectors into a single node update vector; and

5 instructions executed on the microprocessor of the machine for updating the first control point by moving the first control point a fraction of the single node update vector.

10 20. The machine of Claim 17 further comprising:

instructions executed on the microprocessor of the machine for storing values for multiple source bundle fields and multiple target bundle fields; and

15 instructions executed on the microprocessor of the machine for determining multiple source field values, the multiple source field values corresponding to multiple source control points, the multiple source control points being in a neighborhood of a target control point,

20 wherein a position of the target control point is modified using the source field values, and wherein the stress on the target control point in a node of the hierarchical multidimensional scaling database is minimized.

25

;